IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Shilin Chen
Serial No.:	To be Assigned
Filing Date:	January 28, 2004
Group Art Unit:	To be Assigned
Examiner:	To be Assigned
Title:	**ROLLER-CONE BITS, SYSTEMS, DRILLING METHODS, AND DESIGN METHODS WITH OPTIMIZATION OF TOOTH ORIENTATION**

Mail Stop PATENT APPLICATION

Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

REQUEST FOR INTERFERENCE WITH PATENT APPLICATION

PURSUANT TO 37 C.F.R. 1.604

Claims 1-36 of this Continuation patent application are copied from U.S. Patent Application No. 10/443,196 (the "'196 Application"), filed on May 22, 2003 and published on October 23, 2003 (Publication No. U.S. 2003/0196835 A1). Accordingly, Applicant respectfully requests that the Examiner declare an Interference between the present Application and the '196 Application.

REMARKS

Claims 1-36 of this Continuation patent application are copied from the '196 Application. Claims 1-36 of the present Application correspond to Claims 1, 3-7, 14, 15, 18, 20, 22-24, 27, 31-33, 36, 42-44, 47, 51-53, 56, 63, 64, 67, 71-73, 76, 78, 84 and 96, respectively, of the '196 Application.

Applicant's compliance with 37 C.F.R. §1.604 with respect to Applicant's request that the Examiner declare an Interference between the present Application and the '196 Application, is indicated below:

I. 37 C.F.R. §1.604(a)(1)

Applicant proposes the following count:

> A drill bit comprising: a bit body; at least one roller cone attached to the bit body and able to rotate with respect to the bit body; and a plurality of cutting elements disposed on the at least one roller cone, at least one bit design parameter selected so that the cutting elements wear in a selected manner when drilling an earth formation.

Claim 1 of the present Application corresponds exactly to the count.

II. 37 C.F.R. §1.604(a)(2)

Applicant respectfully requests that the Examiner declare an interference between the present Application and the '196 Application. Claim 1 of the '196 Application corresponds exactly to the proposed count of Section I, above.

III. 37 C.F.R. §1.604(a)(3)

The Interference should be declared because, as shown by the table below, the present Application and the '196 Application claim the same invention.

The Present Application	The '196 Application
1. A drill bit comprising: a bit body; at least one roller cone attached to the bit body and able to rotate with respect to the bit body; and a plurality of cutting elements disposed on the at least one roller cone, at least one bit design parameter selected so that the cutting elements wear in a selected manner when drilling an earth formation.	1. A drill bit comprising: a bit body; at least one roller cone attached to the bit body and able to rotate with respect to the bit body; and a plurality of cutting elements disposed on the at least one roller cone, at least one bit design parameter selected so that the cutting elements wear in a selected manner when drilling an earth formation.
2. The drill bit of claim 1, wherein the at least one bit design parameter is selected to optimize a rate of penetration over the life of the drill bit.	3. The drill bit of claim 1, wherein the at least one bit design parameter is selected to optimize a rate of penetration over the life of the drill bit.
3. The drill bit of claim 1, wherein the at least one bit design parameter is selected to maximize a total life of the drill bit.	4. The drill bit of claim 1, wherein the at least one bit design parameter is selected to maximize a total life of the drill bit.
4. The drill bit of claim 1, wherein the at least one bit design parameter is selected to optimize a rate of penetration and maximize a total life of the drill bit.	5. The drill bit of claim 1, wherein the at least one bit design parameter is selected to optimize a rate of penetration and maximize a total life of the drill bit.
5. The drill bit of claim 1, wherein the at least one bit design parameter is selected to substantially optimize a distribution of axial forces over the drill bit over the life of the drill bit.	6. The drill bit of claim 1, wherein the at least one bit design parameter is selected to substantially optimize a distribution of axial forces over the drill bit over the life of the drill bit.
6. The drill bit of claim 1, wherein the drill bit comprises a plurality of roller cones having cutting elements thereon, the at least one bit design parameter selected to substantially balance	7. The drill bit of claim 1, wherein the drill bit comprises a plurality of roller cones having cutting elements thereon, the at least one bit design parameter selected to substantially balance

axial forces between roller cones over the life of the drill bit.

7. The drill bit of claim 1, wherein the at least one bit design parameter is selected to substantially optimize work performed over the drill bit over the life of the drill bit.

8. The drill bit of claim 1, wherein the drill bit comprises a plurality of roller cones having cutting elements thereon, the at least one bit design parameter selected to substantially balance work performed between roller cones over the life of the drill bit.

9. The drill bit of claim 1, wherein the at least one bit design parameter is selected to substantially optimize a volume of formation cut by cutting elements over the drill bit over the life of the drill bit.

10. The drill bit of claim 1, wherein the drill bit comprises a plurality of roller cones having cutting elements thereon, the at least one bit design parameter selected to substantially balance a volume of formation cut by cutting elements between roller cones over the life of the drill bit.

11. The drill bit of claim 1, wherein the at least one bit design parameter is selected to increase durability of the drill bit.

12. The drill bit of claim 11, wherein the at least one bit design parameter comprises cutting element material.

13. The drill bit of claim 12, wherein the cutting element material comprises tungsten carbide.

axial forces between roller cones over the life of the drill bit.

14. The drill bit of claim 1, wherein the at least one bit design parameter is selected to substantially optimize work performed over the drill bit over the life of the drill bit.

15. The drill bit of claim 1, wherein the drill bit comprises a plurality of roller cones having cutting elements thereon, the at least one bit design parameter selected to substantially balance work performed between roller cones over the life of the drill bit.

18. The drill bit of claim 1, wherein the at least one bit design parameter is selected to substantially optimize a volume of formation cut by cutting elements over the drill bit over the life of the drill bit.

20. The drill bit of claim 1, wherein the drill bit comprises a plurality of roller cones having cutting elements thereon, the at least one bit design parameter selected to substantially balance a volume of formation cut by cutting elements between roller cones over the life of the drill bit.

22. The drill bit of claim 1, wherein the at least one bit design parameter is selected to increase durability of the drill bit.

23. The drill bit of claim 22, wherein the at least one bit design parameter comprises cutting element material.

24. The drill bit of claim 23, wherein the cutting element material comprises tungsten carbide.

14. The drill bit of claim 12, wherein the cutting elements are formed from at least two different materials.

15. The drill bit of claim 14, wherein at least one of the at least two different materials comprises a hardfacing material.

16. The drill bit of claim 11, wherein the at least one bit design parameter comprises a number of cutting elements.

17. The drill bit of claim 11, wherein the at least one bit design parameter comprises a hardness of a cutting element material.

18. The drill bit of claim 11, wherein the at least one bit design parameter comprises cutting element geometry.

19. The drill bit of claim 1, wherein the at least one bit design parameter is selected to minimize wear of the cutting elements.

20. The drill bit of claim 19, wherein the at least one bit design parameter comprises cutting element material.

21. The drill bit of claim 20, wherein the cutting element material comprises tungsten carbide.

22. The drill bit of claim 20, wherein the cutting elements are formed from at least two different materials.

23. The drill bit of claim 22, wherein at least one of the at least two different materials comprises a hardfacing material.

27. The drill bit of claim 23, wherein the cutting elements are formed from at least two different materials.

31. The drill bit of claim 27, wherein at least one of the at least two different materials comprises a hardfacing material.

32. The drill bit of claim 22, wherein the at least one bit design parameter comprises a number of cutting elements.

33. The drill bit of claim 22, wherein the at least one bit design parameter comprises a hardness of a cutting element material.

36. The drill bit of claim 22, wherein the at least one bit design parameter comprises cutting element geometry.

42. The drill bit of claim 1, wherein the at least one bit design parameter is selected to minimize wear of the cutting elements.

43. The drill bit of claim 42, wherein the at least one bit design parameter comprises cutting element material.

44. The drill bit of claim 43, wherein the cutting element material comprises tungsten carbide.

47. The drill bit of claim 43, wherein the cutting elements are formed from at least two different materials.

51. The drill bit of claim 47, wherein at least one of the at least two different materials comprises a hardfacing material.

24. The drill bit of claim 19, wherein the at least one bit design parameter comprises a number of cutting elements.

25. The drill bit of claim 19, wherein the at least one bit design parameter comprises a hardness of a cutting element material.

26. The drill bit of claim 19, wherein the at least one bit design parameter comprises cutting element geometry.

27. The drill bit of claim 1, wherein the at least one bit design parameter comprises cutting element material.

28. The drill bit of claim 27, wherein the cutting element material comprises tungsten carbide.

29. The drill bit of claim 27, wherein the cutting elements are formed from at least two different materials.

30. The drill bit of claim 29, wherein at least one of the at least two different materials comprises a hardfacing material.

31. The drill bit of claim 1, wherein the at least one bit design parameter comprises a number of cutting elements.

32. The drill bit of claim 31, wherein the at least one bit design parameter comprises a hardness of a cutting element material.

33. The drill bit of claim 31, wherein the at least one bit design parameter comprises cutting element geometry.

52. The drill bit of claim 42, wherein the at least one bit design parameter comprises a number of cutting elements.

53. The drill bit of claim 42, wherein the at least one bit design parameter comprises a hardness of a cutting element material.

56. The drill bit of claim 42, wherein the at least one bit design parameter comprises cutting element geometry.

63. The drill bit of claim 62, wherein the at least one bit design parameter comprises cutting element material.

64. The drill bit of claim 63, wherein the cutting element material comprises tungsten carbide.

67. The drill bit of claim 63, wherein the cutting elements are formed from at least two different materials.

71. The drill bit of claim 67, wherein at least one of the at least two different materials comprises a hardfacing material.

72. The drill bit of claim 62, wherein the at least one bit design parameter comprises a number of cutting elements.

73. The drill bit of claim 62, wherein the at least one bit design parameter comprises a hardness of a cutting element material.

76. The drill bit of claim 62, wherein the at least one bit design parameter comprises cutting element geometry.

34. The drill bit of claim 1, wherein the at least one bit design parameter comprises a number of cutting elements on each roller cone.	78. The drill bit of claim 77, wherein the at least one bit design parameter comprises a number of cutting elements on each roller cone.
35. The drill bit of claim 1, wherein the cutting element material comprises tungsten carbide.	84. The drill bit of claim 83, wherein the cutting element material comprises tungsten carbide.
36. The drill bit of claim 1, wherein the at least one bit design parameter comprises cutting element geometry.	96. The drill bit of claim 82, wherein the at least one bit design parameter comprises cutting element geometry.

There are no differences between Claims 1-36 of the present Application, and Claims 1, 3-7, 14, 15, 18, 20, 22-24, 27, 31-33, 36, 42-44, 47, 51-53, 56, 63, 64, 67, 71-73, 76, 78, 84 and 96, respectively of the '196 Application listed side-by-side above. Thus, it is clear that the parties are claiming the same patentable invention.

V. 37 C.F.R. §1.604(a)(5) SUPPORT FOR COPIED CLAIMS

Applicant respectfully contends that Claims 1-36 of the present Application are fully supported by the specification of the present Application, as originally filed. Applicant provides below, examples of specific portions of the specification that support specific claim limitations of Claims 1-36. Applicant does not intend this list to be exhaustive of all support for Claims 1-36 that is present in the specification of the present Application.

For the convenience of the Examiner, Applicant has reproduced specific portions of the specification of the present Application, in the attached Exhibit A. Such portions were reproduced from the cited "Support in the Specification", below, and are applied to their respective claim limitations in Exhibit A.

Unless otherwise noted, the citations below in the column entitled "Support in the Specification" refer to the present Continuation patent application. The present Continuation patent application incorporates by reference, U.S. Patent No. 6,213,225 at page 8, lines 18-27. Therefore, where indicated below, support for new claims is provided with reference to U.S. Patent No. 6,213,225.

Claims	Support in the Specification
1. A drill bit comprising: a bit body; at least one roller cone attached to the bit body and able to rotate with respect to the bit body; and a plurality of cutting elements disposed on the at least one roller cone, at least one bit design parameter selected so that the cutting elements wear in a selected manner when drilling an earth formation.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
2. The drill bit of claim 1, wherein the at least one bit design parameter is selected to optimize a rate of penetration over the life of the drill bit.	Page 6, lines 17-21 Page 15, lines 19-23
3. The drill bit of claim 1, wherein the at least one bit design parameter is selected to maximize a total life of the drill	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14

bit.	Page 5, lines 25-31
4. The drill bit of claim 1, wherein the at least one bit design parameter is selected to optimize a rate of penetration and maximize a total life of the drill bit.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31 Page 6, lines 17-21 Page 15, lines 19-23
5. The drill bit of claim 1, wherein the at least one bit design parameter is selected to substantially optimize a distribution of axial forces over the drill bit over the life of the drill bit.	U.S. PATENT NO. 6,213,225: Abstract U.S. PATENT NO. 6,213,225: Column 4, lines 50-51
6. The drill bit of claim 1, wherein the drill bit comprises a plurality of roller cones having cutting elements thereon, the at least one bit design parameter selected to substantially balance axial forces between roller cones over the life of the drill bit.	U.S. PATENT NO. 6,213,225: Abstract U.S. PATENT NO. 6,213,225: Column 4, lines 50-51
7. The drill bit of claim 1, wherein the at least one bit design parameter is selected to substantially optimize work performed over the drill bit over the life of the drill bit.	U.S. PATENT NO. 6,213,225: Abstract U.S. PATENT NO. 6,213,225: Column 4, lines 50-51 Page 12, lines 16-17
8. The drill bit of claim 1, wherein the drill bit comprises a plurality of roller cones having cutting elements thereon, the at least one bit design parameter selected to substantially balance work performed between roller cones over the life of the drill bit.	U.S. PATENT NO. 6,213,225: Abstract U.S. PATENT NO. 6,213,225: Column 4, lines 50-51 Page 12, lines 16-17
9. The drill bit of claim 1, wherein the at least one bit design parameter is selected to substantially optimize a volume of formation cut by cutting elements over the drill bit over the life of the drill bit.	U.S. PATENT NO. 6,213,225: Column 8, lines 51-52 U.S. PATENT NO. 6,213,225: Column 10, lines 10-23
10. The drill bit of claim 1, wherein the drill bit comprises a plurality of roller cones having cutting elements thereon, the at least one bit design parameter selected to substantially balance a volume of formation	U.S. PATENT NO. 6,213,225: Column 8, lines 51-52 U.S. PATENT NO. 6,213,225: Column 10, lines 10-23

cut by cutting elements between roller cones over the life of the drill bit.	
11. The drill bit of claim 1, wherein the at least one bit design parameter is selected to increase durability of the drill bit.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
12. The drill bit of claim 11, wherein the at least one bit design parameter comprises cutting element material.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
13. The drill bit of claim 12, wherein the cutting element material comprises tungsten carbide.	Page 3, lines 28-32
14. The drill bit of claim 12, wherein the cutting elements are formed from at least two different materials.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
15. The drill bit of claim 14, wherein at least one of the at least two different materials comprises a hardfacing material.	Page 3, lines 28-32
16. The drill bit of claim 11, wherein the at least one bit design parameter comprises a number of cutting elements.	U.S. PATENT NO. 6,213,225: Column 10, lines 10-23
17. The drill bit of claim 11, wherein the at least one bit design parameter comprises a hardness of a cutting element material.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
18. The drill bit of claim 11, wherein the at least one bit design parameter comprises cutting element geometry.	Page 12, lines 13-17
19. The drill bit of claim 1, wherein the at least one bit design parameter is selected to minimize wear of the cutting elements.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31

20. The drill bit of claim 19, wherein the at least one bit design parameter comprises cutting element material.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
21. The drill bit of claim 20, wherein the cutting element material comprises tungsten carbide.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
22. The drill bit of claim 20, wherein the cutting elements are formed from at least two different materials.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
23. The drill bit of claim 22, wherein at least one of the at least two different materials comprises a hardfacing material.	Page 3, lines 28-32
24. The drill bit of claim 19, wherein the at least one bit design parameter comprises a number of cutting elements.	U.S. PATENT NO. 6,213,225: Column 10, lines 10-23
25. The drill bit of claim 19, wherein the at least one bit design parameter comprises a hardness of a cutting element material.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
26. The drill bit of claim 19, wherein the at least one bit design parameter comprises cutting element geometry.	Page 12, lines 13-17
27. The drill bit of claim 1, wherein the at least one bit design parameter comprises cutting element material.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
28. The drill bit of claim 27, wherein the cutting element material comprises tungsten carbide.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
29. The drill bit of claim 27, wherein the cutting elements are formed from at least two different materials.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31

30. The drill bit of claim 29, wherein at least one of the at least two different materials comprises a hardfacing material.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
31. The drill bit of claim 1, wherein the at least one bit design parameter comprises a number of cutting elements.	U.S. PATENT NO. 6,213,225: Column 10, lines 10-23
32. The drill bit of claim 31, wherein the at least one bit design parameter comprises a hardness of a cutting element material.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
33. The drill bit of claim 31, wherein the at least one bit design parameter comprises cutting element geometry.	Page 12, lines 13-17
34. The drill bit of claim 1, wherein the at least one bit design parameter comprises a number of cutting elements on each roller cone.	U.S. PATENT NO. 6,213,225: Column 10, lines 10-23
35. The drill bit of claim 1, wherein the cutting element material comprises tungsten carbide.	Page 3, lines 28-32 Page 3, lines 8-13 Page 4, lines 13-14 Page 5, lines 25-31
36. The drill bit of claim 1, wherein the at least one bit design parameter comprises cutting element geometry.	Page 12, lines 13-17

VI. REQUEST FOR THE BENEFIT OF THE FILING DATES OF APPLICANT'S PRIORITY APPLICATIONS

Applicant claims priority under 35 USC 120 based upon U.S. Patent Application Serial No. 10/189,305 (the "'305 Application"), filed July 2, 2002, which is a Continuation of U.S. Patent Application Serial No. 09/629,344, filed August 1, 2000, now U.S. Patent No. 6,412,577 (the "'577 Patent"), which is a continuation of U.S. Patent Application Serial No. 09/387,304, filed August 31, 1999, now U.S. Patent No. 6,095,262 (the "'262 Patent"), which claims priority under 35 USC 119(e) based on provisional application No. 60/098,442 filed August 31, 1998. The present Application is a continuation of the '305 Application, which is a Continuation of the '577 Patent, which is a Continuation of the '262 Patent. Therefore, the application of the terms of claims 22-29 to the specification of the present Application in Section IV above applies to the '305 Application, and the '577 and '262 Patents, as well (although page and line designations will vary).

The August 31, 1999 filing date of the '262 Patent preceeds the January 31, 2001 filing date of U.S. Patent Application Serial No. 09/775,530, the purported parent application of the '196 Application. Therefore, Chen, the inventor of the present application, should be the senior party in the interference.

Conclusions

Applicant has made an earnest attempt to place this case in condition for allowance. For the foregoing reasons, and for other reasons clearly apparent, Applicant respectfully requests full allowance of all pending claims. Furthermore, Applicant respectfully requests that the Examiner declare an Interference between the present Application and the '196 Application. If the Examiner feels that a telephone conference or an interview would advance prosecution of the present Application in any manner, the undersigned attorney for Applicant stands ready to conduct such a conference at the convenience of the Examiner.

If the Examiner determines that at least one of the claims copied from the '196 Application is allowable, Applicant respectfully requests that the Examiner declare an interference, in accordance with MPEP 2303, which states:

> If the applications each contain one claim drawn to the same patentable invention (37 CFR 1.601(n)), the Examiner proceeds to propose the interference . . ..

Applicant believes no fees are due with this request for interference. However, in the event of a fee discrepancy, the Commissioner is hereby authorized to charge any fees or credit any overpayments to Deposit Account No. 50-2148 of Baker Botts L.L.P.

If there are matters that can be discussed by telephone to further the prosecution of this application, Applicant respectfully requests that the Examiner contact the undersigned.

Respectfully submitted,

BAKER BOTTS L.L.P.
Attorneys for Applicant

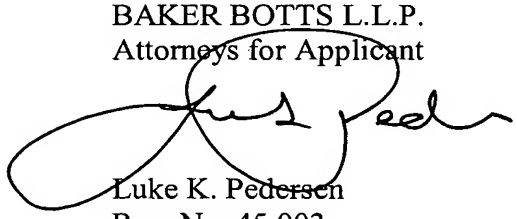

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EXHIBIT A
Support for Claims 1-36

Reproduced below, are portions of the specification of the present Continuation patent application that are examples of support in the present Continuation patent application for each limitation of Claims 1-36 delineated below. Where indicated, support is cited from the '225 Patent. As discussed above, the '225 Patent is incorporated by reference, into the present Continuation patent application. This list is not intended to be exhaustive.

I. Support for Claim 1

A. ***A drill bit comprising:***
a bit body;
at least one roller cone attached to the bit body and able to rotate with respect to the bit body; and
a plurality of cutting elements disposed on the at least one roller cone, at least one bit design parameter selected so that the cutting elements wear in a selected manner when drilling an earth formation.

1. Steel-tooth bits have steel teeth formed integral to the cone. (A hardmetal is typically applied to the surface of the teeth to improve the wear resistance of the structure.) Insert bits have very hard inserts (e.g. specially selected grades of tungsten carbide) pressed into holes drilled into the cone surfaces. The inserts extend outwardly beyond the surface of the cones to form the "teeth" that comprise the cutting structures of the drill bit. *See Page 3, lines 28-32*

2. Drill string oscillations change the instantaneous force on the bit, and that means that the bit will not operate as designed. For example, the bit may drill oversize, or off-center, or may wear out much sooner than expected. *See Page 3, lines 8-13*

3. Gage row teeth (i.e. the teeth in the outermost row of the cone, next to the outer diameter of the borehole) may have a "T" shaped crest for additional wear resistance. *See Page 4, lines 13-14*

4. Tracking occurs when the teeth of a drill bit fall into the impressions in the formation formed by other teeth at a preceding moment in time during the revolution of the drill bit. Gyration occurs when a drill bit fails to drill on-center. Both phenomena result in slow rates of penetration, detrimental wear of the cutting structures and premature failure of bits. Other detrimental conditions include excessive uncut rings in the bottom hole pattern. This condition can cause gyration, result in slow rates of penetration, detrimental wear of the cutting structures and premature failure of the bits. *See Page 5, lines 25-31*

II. Support for Claim 2

A. ***The drill bit of claim 1, wherein the at least one bit design parameter is selected to optimize a rate of penetration over the life of the drill bit.***

1. Background: Shortcomings of Existing Bit Designs The economics of drilling a well are strongly reliant on rate of penetration. Since the design of the cutting structure of a drill bit controls the bit's ability to achieve a high rate of penetration, cutting structure design plays a significant role in the overall economics of drilling a well. Current bit designs have not solved the issue of tracking. Complex mathematical models can simulate

bottom hole patterns to a limited extent, but they do not suggest a solution to the ever-present problem of tracking. The known angular orientations of teeth designed to improve tooth impact strength leave excessive uncut bottom hole patterns and do not solve the problem of tracking. The known angular orientations of teeth designed to increase bottom hole coverage, fail to optimize tooth orientation and do not solve the problem of tracking. Staggered tooth designs do not prevent tracking of the outermost rows of teeth. On the outermost rows of each cone, the teeth are encountering impressions in the formation left by teeth on other cones. The staggered teeth are just as likely to track an impression as any other tooth. Another disadvantage to staggered designs is that they may cause fluctuations in cone rotational speed, resulting in fluctuations in tooth impact force and increased bit vibration. Bit vibration is very harmful to the life of the bit and the life of the entire drill string. *See Page 6, lines 17-21*

2. In this way it is clearly seen how the tooth scrapes over the bottom. However for the bit manufacturer or bit designer it is necessary to know the teeth orientation angle on the cone coordinate, in order either to keep the elongate side of the tooth perpendicular to the scraping direction (for maximum cutting rate in softer formations) or to keep the elongate side of the tooth in line with the scraping direction (for durability in harder formations). *See Page 15, lines 19-23*

III. Support for Claim 3

A. ***The drill bit of claim 1, wherein the at least one bit design parameter is selected to maximize a total life of the drill bit.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

IV. Support for Claim 4

A. ***The drill bit of claim 1, wherein the at least one bit design parameter is selected to optimize a rate of penetration and maximize a total life of the drill bit.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*
5. See paragraph II(A)(1) above. *See Page 6, lines 17-21*
6. See paragraph II(A)(2) above. *See Page 15, lines 19-23*

V. Support for Claim 5

A. ***The drill bit of claim 1, wherein the at least one bit design parameter is selected to substantially optimize a distribution of axial forces over the drill bit over the life of the drill bit.***

1. Roller cone drilling wherein the bit optimization process equalizes the downforce (axial force) for the cones (as nearly as possible, subject to other design

constraints). Bit performance is significantly enhanced by equalizing downforce. *See U.S. PATENT NO. 6,213,225: Abstract*

2. The present application teaches that roller cone bit designs should have equal mechanical downforce on each of the cones. *See U.S. PATENT NO. 6,213,225: Column 4, lines 50-51*

VI. Support for Claim 6

A. ***The drill bit of claim 1, wherein the drill bit comprises a plurality of roller cones having cutting elements thereon, the at least one bit design parameter selected to substantially balance axial forces between roller cones over the life of the drill bit.***

1. See paragraph V(A)(1) above. *See U.S. PATENT NO. 6,213,225: Abstract*

2. See paragraph V(A)(2) above. *See U.S. PATENT NO. 6,213,225: Column 4, lines 50-51*

VII. Support for Claim 7

A. ***The drill bit of claim 1, wherein the at least one bit design parameter is selected to substantially optimize work performed over the drill bit over the life of the drill bit.***

1. See paragraph V(A)(1) above. *See U.S. PATENT NO. 6,213,225: Abstract*

2. See paragraph V(A)(2) above. *See U.S. PATENT NO. 6,213,225: Column 4, lines 50-51*

3. The coordinate of a tooth's crest point $\mathbf{P_t}$ will be defined by parameters of the tooth profile (e.g. tooth diameter, extension, etc.). *See Page 12, lines 16-17*

VIII. Support for Claim 8

A. ***The drill bit of claim 1, wherein the drill bit comprises a plurality of roller cones having cutting elements thereon, the at least one bit design parameter selected to substantially balance work performed between roller cones over the life of the drill bit.***

1. See paragraph V(A)(1) above. *See U.S. PATENT NO. 6,213,225: Abstract*

2. See paragraph V(A)(2) above. *See U.S. PATENT NO. 6,213,225: Column 4, lines 50-51*

3. See paragraph VII(A)(3) above. *See Page 12, lines 16-17*

IX. Support for Claim 9

A. ***The drill bit of claim 1, wherein the at least one bit design parameter is selected to substantially optimize a volume of formation cut by cutting elements over the drill bit over the life of the drill bit.***

1. According to equation (1), the force acting on an element is proportional to the rock volume removed by that element. *See U.S. PATENT NO. 6,213,225: Column 8, lines 51-52*

2. In the preferred embodiment of the present disclosure, a roller cone bit is provided for which the volume of formation removed by each tooth in each row, of each cutting structure (cone), is calculated. This calculation is based on input data of bit geometry, rock properties, and operational parameters. The geometric parameters of the roller cone bit are then modified such that the volume of formation removed by each cutting structure is equalized. Since the amount of formation removed by any tooth on a cutting structure is a function of the force imparted on the formation by the tooth, the volume of formation removed by a cutting structure is a direct function of the force applied to the cutting structure. By balancing the volume of formation removed by all cutting structures, force balancing is also achieved. *See U.S. PATENT NO. 6,213,225: Column 10, lines 10-23*

X. Support for Claim 10

A. ***The drill bit of claim 1, wherein the drill bit comprises a plurality of roller cones having cutting elements thereon, the at least one bit design parameter selected to substantially balance a volume of formation cut by cutting elements between roller cones over the life of the drill bit.***

1. See paragraph IX(A)(1) above. *See U.S. PATENT NO. 6,213,225: Column 8, lines 51-52*

2. See paragraph IX(A)(2) above. *See U.S. PATENT NO. 6,213,225: Column 10, lines 10-23*

XI. Support for Claim 11

A. ***The drill bit of claim 1, wherein the at least one bit design parameter is selected to increase durability of the drill bit.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XII. Support for Claim 12

A. ***The drill bit of claim 11, wherein the at least one bit design parameter comprises cutting element material.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XIII. Support for Claim 13

A. ***The drill bit of claim 12, wherein the cutting element material comprises tungsten carbide.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*

XIV. Support for Claim 14

A. ***The drill bit of claim 12, wherein the cutting elements are formed from at least two different materials.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XV. Support for Claim 15

A. ***The drill bit of claim 14, wherein at least one of the at least two different materials comprises a hardfacing material.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*

XVI. Support for Claim 16

A. ***The drill bit of claim 11, wherein the at least one bit design parameter comprises a number of cutting elements.***

1. See paragraph IX(A)(2) above. *See U.S. PATENT NO. 6,213,225: Column 10, lines 10-23*

XVII. Support for Claim 17

A. ***The drill bit of claim 11, wherein the at least one bit design parameter comprises a hardness of a cutting element material.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XVIII. Support for Claim 18

A. ***The drill bit of claim 11, wherein the at least one bit design parameter comprises cutting element geometry.***

1. **Figure 13** shows a sample XYZ plot of a tooth tip (in tooth local coordinates). Tooth coordinates will be indicated here by the subscript t. (Of course, each tooth has its own tooth coordinate system.) The center of the $\mathbf{X_tY_tZ_t}$ coordinate system, in the presently preferred embodiment, is located at the tooth center. The coordinate of a tooth's crest point $\mathbf{P_t}$ will be defined by parameters of the tooth profile (e.g. tooth diameter, extension, etc.). *See Page 12, lines 13-17*

XIX. Support for Claim 19

A. ***The drill bit of claim 1, wherein the at least one bit design parameter is selected to minimize wear of the cutting elements.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XX. Support for Claim 20

A. ***The drill bit of claim 19, wherein the at least one bit design parameter comprises cutting element material.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XXI. Support for Claim 21

A. ***The drill bit of claim 20, wherein the cutting element material comprises tungsten carbide.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XXII. Support for Claim 22

A. ***The drill bit of claim 20, wherein the cutting elements are formed from at least two different materials.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*

4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XXIII. Support for Claim 23

A. ***The drill bit of claim 22, wherein at least one of the at least two different materials comprises a hardfacing material.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*

XXIV. Support for Claim 24

A. ***The drill bit of claim 19, wherein the at least one bit design parameter comprises a number of cutting elements.***

1. See paragraph IX(A)(2) above. *See U.S. PATENT NO. 6,213,225: Column 10, lines 10-23*

XXV. Support for Claim 25

A. ***The drill bit of claim 19, wherein the at least one bit design parameter comprises a hardness of a cutting element material.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XXVI. Support for Claim 26

A. ***The drill bit of claim 19, wherein the at least one bit design parameter comprises cutting element geometry.***

1. See paragraph XVIII above. *See Page 12, lines 13-17*

XXVII. Support for Claim 27

A. ***The drill bit of claim 1, wherein the at least one bit design parameter comprises cutting element material.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XXVIII. Support for Claim 28

A. ***The drill bit of claim 27, wherein the cutting element material comprises tungsten carbide.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XXIX. Support for Claim 29

A. ***The drill bit of claim 27, wherein the cutting elements are formed from at least two different materials.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XXX. Support for Claim 30

A. ***The drill bit of claim 29, wherein at least one of the at least two different materials comprises a hardfacing material.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XXXI. Support for Claim 31

A. ***The drill bit of claim 1, wherein the at least one bit design parameter comprises a number of cutting elements.***

1. See paragraph IX(A)(2) above. *See U.S. PATENT NO. 6,213,225: Column 10, lines 10-23*

XXXII. Support for Claim 32

A. ***The drill bit of claim 31, wherein the at least one bit design parameter comprises a hardness of a cutting element material.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XXXIII. Support for Claim 33

A. ***The drill bit of claim 31, wherein the at least one bit design parameter comprises cutting element geometry.***

1. See paragraph XVIII above. *See Page 12, lines 13-17*

XXXIV. Support for Claim 34

A. ***The drill bit of claim 1, wherein the at least one bit design parameter comprises a number of cutting elements on each roller cone.***

1. See paragraph IX(A)(2) above. *See U.S. PATENT NO. 6,213,225: Column 10, lines 10-23*

XXXV. Support for Claim 35

A. ***The drill bit of claim 1, wherein the cutting element material comprises tungsten carbide.***

1. See paragraph I(A)(1) above. *See Page 3, lines 28-32*
2. See paragraph I(A)(2) above. *See Page 3, lines 8-13*
3. See paragraph I(A)(3) above. *See Page 4, lines 13-14*
4. See paragraph I(A)(4) above. *See Page 5, lines 25-31*

XXXVI. Support for Claim 36

A. ***The drill bit of claim 1, wherein the at least one bit design parameter comprises cutting element geometry.***

1. See paragraph XVIII above. *See Page 12, lines 13-17*